RUB-TP2-17/99

Polarized antiquark distributions from chiral quark-soliton model: summary of the results

K. Goeke[a], P.V. Pobylitsa[a,b], M.V. Polyakov[a,b] and D. Urbano[a,c]

[a] *Institute for Theoretical Physics II, Ruhr University Bochum, Germany*
[b] *Petersburg Nuclear Physics Institute, Gatchina, St. Petersburg 188350, Russia*
[c] *Faculdade de Engenharia da Universidade do Porto, 4000 Porto, Portugal*

Abstract

In these short notes we present a parametrization of the results obtained in the chiral quark-soliton model for polarized antiquark distributions $\Delta\bar{u}$, $\Delta\bar{d}$ and $\Delta\bar{s}$ at a low normalization point around $\mu = 0.6$ GeV.

The aim of these short notes is to summarize the results for the polarized antiquark distributions $\Delta\bar{u}$, $\Delta\bar{d}$ and $\Delta\bar{s}$ obtained in refs. [1, 2, 3] in the framework of the chiral quark-soliton model.

The chiral quark-soliton model [4] is a low-energy field theoretical model of the nucleon structure which allows a consistent calculations of leading twist quark and antiquark distributions [1]. Due to its field theoretical nature the quark and antiquark distributions obtained in this model satisfy all general QCD requirements: positivity, sum rules, inequalities, etc.

A remarkable prediction of the chiral quark soliton model, noted first in ref. [1], is the strong flavour asymmetry of polarized antiquarks, the feature which is missing in other models like, for instance, pion cloud models (for discussion of this point see Ref. [5]).

The fits below are based on the calculations of Refs. [1, 2, 3], generalized to the case of three flavours. The results of these calculations are fitted by the form inspired by quark counting rules discussed in Ref. [6]:

$$\Delta\bar{q}(x) \;=\; \frac{1}{x^{\alpha_q}}\left[A_q(1-x)^5 + B_q(1-x)^6\right], \tag{1}$$

which leads to

$$\begin{aligned} \alpha_u &= 0.0542,\ \alpha_d = 0.0343,\ \alpha_s = 0.0169 \\ A_u &= 0.319,\ A_d = -0.185,\ A_s = -0.0366 \\ B_u &= 0.589,\ B_d = -0.672,\ B_s = -0.316\,. \end{aligned} \tag{2}$$

In Fig. 1 we plot the resulting distribution functions. We note that these functions, obtained in the framework of the chiral quark soliton model, refer to the normalization point of about $\mu = 0.6$ GeV.

A few comments are in order here:

- The model calculations are not justified at x close to zero and one. Therefore the small x and $x \to 1$ behaviours obtained in the the fit above should be consider as an educated guess only, not as model prediction.

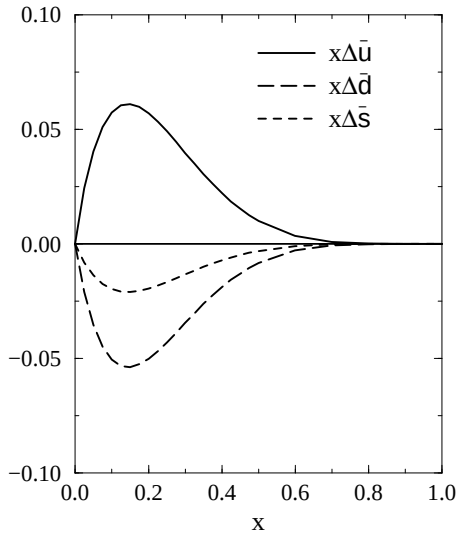

Figure 1: Results for $x\Delta\bar{u}(x)$, $x\Delta\bar{d}(x)$ and $x\Delta\bar{s}(x)$ at low normalization point obtained in chiral quark soliton model

- We estimate that the theoretical errors related to the approximations ($1/N_c$ corrections, m_s corrections, etc.) done in the model calculations are at the level of 20%-30% for $\Delta\bar{u}$ and $\Delta\bar{d}$, and around 50% for $\Delta\bar{s}$. The value of the normalization point is not known exactly, the most favoured value is $\mu = 0.6$ GeV.

The measurements of flavour asymmetry of polarized antiquarks, say, in semi-inclusive DIS [5] or in Drell-Yan reactions with polarized protons [7] would allow to discriminate between different pictures of the nucleon.

References

[1] D.I. Diakonov, V.Yu. Petrov, P.V. Pobylitsa, M.V. Polyakov and C. Weiss, Nucl. Phys. **B 480** (1996) 341; Phys. Rev. **D 56** (1997) 4069.

[2] M. Penttinen, M.V. Polyakov, K. Goeke, hep-ph/9909489, to appear in Phys. Rev. D.

[3] K. Goeke *et al.*, Preprint RUB-TPII-18/99, hep-ph/0001272.

[4] D.I. Diakonov, V.Yu. Petrov, and P.V. Pobylitsa, Nucl. Phys. **B 306** (1988) 809. For a review of the foundations of this model see: D.I. Diakonov, hep-ph/9802298.

[5] B. Dressler, K. Goeke, M.V. Polyakov, and C. Weiss, hep-ph/9909541.

[6] S.J. Brodsky, M. Burkhardt and I. Schmidt, Nucl. Phys. **B441** (1995) 197.

[7] B. Dressler, *et al.*, hep-ph/9910464.